FINDINGS OF COMPLIANCE

DREDGED MATERAIL DISPOSAL ACTIVITIES IN

SKAMOKAWA CREEK FEDERAL NAVIGATION CHANNÉL

May 1980

1. Background. Skamokawa Creek is located near river mile (RM) 33.5 on the Washington side of Columbia River (figure 1). Dredging of a channel in Skamokawa Creek was authorized by the River and Harbor Act of 1919 and was completed in 1920. The Corps of Engineers is responsible for maintaining a short navigation channel 6.5 feet deep and 75 feet wide from the mouth of the creek to the unincorporated town of Skamokawa, Washington; a distance of 1,600 feet.

2. The tidal range at the project is about 7 feet. It is subject to the flow reversals of the Columbia River which have been observed as far upstream as Prescott, Oregon. The area is not exposed to saline ocean waters which extend up the Columbia River to about RM 20. However, the stilling effect caused by tidal cycles tends to increase the amount of sediment deposited in Skamokawa channel.[1]

3. The Skamokawa Creek navigation channel has been maintained with both pipeline and agitation dredges. When pipeline dredges were used, the discharged material was disposed upland along both sides of the creek and the volume of dredged material ranged between 9,400 and 24,700 cubic yards. Pipeline dredges have not been used on the project since 1972. The agitation dredge SANDWICK has been used on an annual basis since 1974 and it is estimated that 2,300 to 8,200 cubic yards of sediment were displaced each year.

4. The Corps proposes to continue using the SANDWICK to maintain Skamokawa Creek Channel. However, it has been found that dredging by the SANDWICK is not as effective as anticipated and the Corps would like to retain the option of using a pipeline dredge.[2] In the latter case, the discharged material would be deposited at one of two upland disposal sites or could be loaded on to a barge and transported downstream to a designated inwater disposal site at

RM 32.68 on the Columbia River (figure 2). Based on past records, it is estimated that 10,000 to 20,000 cubic yards per year would be removed from the navigation channel.

5. Section 404 of the Clean Water Act and Portland District, Corps of Engineers' guidelines specify that sediment and water samples from the dredging site and disposal site must be evaluated prior to dredging to determine if physical, chemical, or biological impacts will result. If sediment consists of fine-grained material (i.e., 20 percent by weight of particles smaller than 0.074mm in diameter) and contains more than 6 percent organic material, chemical data is obtained to determine if potentially harmful levels of contaminants of concern are present.[3]

6. Potential contaminants of concern are indicated by point and nonpoint sources of pollution in the project area. In Skamokawa Creek, point source contamination results from septic tank drainlines flowing directly into the water.[4] The unincorporated town of Skamokawa consists of about 30 residences which are without a municipal sewage system. This is a potential health problem being investigated by the Washington Department of Ecology. There are no industrial discharges into the creek and no discharge permits have been issued.

7. The major nonpoint source of contamination is farmland that surrounds the watershed. Skamokawa Creek flows through a series of dairy farms. It is probable that water runoff containing leachates from pastureland adds nutrients and creates eutrophic conditions in the creek. Evidence supporting this comes from observations of fish kills associated with anoxic conditions[5] in Skamokawa Creek. Small stocks of fall chinook salmon, steelhead, coho salmon, searun cutthroat, and chum salmon are indigenous to the creek. Streamflows can get as low as 30 cfs in late summer above Brooks Slough. Pools containing fish become isolated from flowing water, the biological oxygen demand increases and the oxygen concentration decreases resulting in fish mortalities.

8. Crown Zellerbach Corporation leases log storage space in Steamboat Slough which flows into the lower part of the Skamokawa Creek navigation channel.

From 1968 to 1974, a total of 9,550 logs were stored in the slough. When logs rub together, bark and other debris break and eventually sink to the bottom creating a potential nonpoint source of contamination. Decomposing wood fibers increase the organic content of sediment and sometimes release harmful substances.

9. Methods. On 14-15 May 1980, water and sediment samples were collected for physical and chemical analyses from Skamokawa Creek and Columbia River. A 22-foot trihull, Monarch utility boat with a 2-foot draft was used as a sampling platform. Sediment was collected in Skamokawa Creek at SKRM 0.05, 0.23, and 0.25. Samples collected in the Columbia River at CRM 33.20, 33.35, and 33.55 represent sediment which would be directly affected by the overflowing discharge from the upland disposal sites. Samples collected at CRM 32.68 and 32.85 are characteristics of the in-water disposal sites. Figure 2 shows the sampling locations, dredging area, and upland and in-water disposal sites.

10. Sediment collected for chemical analyses at SKRM 0.25 and 0.23 were taken with a 220-pound, gravity corer equipped to obtain 2-foot cores in detachable, transparent, butyrate acetate core liners. The liners were sealed and stored with ice for transport to the laboratory.

11. At the other sampling stations, violent wave action and coarse sediments precluded use of the gravity corer. Therefore, samples were obtained with 6-inch-by-15-inch, stainless steel cylinder (Ellard sampler) which is closed at one end. Chains and rope are attached to this sampler and it is pulled over the sediment surface. It collects surface material in a localized area.

12. Receiving water was collected by immersing an acid-cleaned, 5-gallon, plastic container 6 inches beneath the surface at CRM 32.68, the in-water disposal site. The receiving water was analyzed separately to determine ambient concentrations of chemicals. It was also used in elutriation of the sediment samples.

13. A Hydrolab 8000 water quality measuring system was used to record dissolved oxygen, pH, conductivity, temperature, and oxidation/reduction

potential at CRM 32.68 and SKRM 0.25. These data are included with the field notes in table 7.

14. The chemical analyses were performed by the U.S. Geological Survey (USGS) using methods detailed in their publications, "Methods for Determination of Inorganic Substances in Water and Fluvial Sediments."[6] These methods were coordinated with and approved by the U.S. Environmental Protection Agency (EPA). Sediment samples from CRM 32.68 and SKRM 0.25 were further analyzed for pesticides, chlorinated hydrocarbons, and bulk sediment chemical concentrations.

15. Sediment analyses for physical characteristics were performed by the Corps' Division Materials Laboratory, Troutdale, Oregon.

RESULTS/DISCUSSION

Physical Characteristics

16. The physical characteristics of Skamokawa Creek and Columbia River sediments are presented in table 1 and figures 3 and 4. The physical analyses include: density of material, void ratio, percent volatile solids, percent organic material, water content, roundness grade, and grain size.

17. The density of sediments is reported as the density of material in place and the density of median solids. The former measurement represents the wet weight of the sediment divided by the weight of an equal volume of water. The latter measure represents the dry weight of a sediment divided by the weight of an equal volume of water. Both values measure the degree of compactness or consolidation of sediment and are comparable to the specific gravity of water. For Skamokawa Creek sediment, the density of median solids ranged between 2,659 and 2,686 g/l. These values are not significantly different than comparable data taken near the upland disposal sites (2,730 to 2,778 g/l) or the inwater disposal site (2,722 to 2,762 g/l).

18. The space between solid particles that is occupied by air and water is called void. The ratio of the volume of the voids to the volume of solids is called the void ratio and is a measure of the porosity of sediments. The void ratios of Skamokawa Creek sediment (1.07 to 1.86) were high compared to similar values at the inwater disposal site (0.87 to 0.88) but similar to sediment near the upland disposal site (1.05 to 1.56).

19. The percent volatile solids and percent organic material represent the amount of combustible carbon in sediment samples. The percent volatile solids is a more realistic value than percent organic material because it represents material that has the greatest potential for chemical interaction. Volatile solids are a rough indicator of the amount of contaminants present in sediments. Sediments high in volatile solids may contain oil and grease and/or naturally occurring organic substances. Volatile solids may be high in sediments collected near fuel docks, log rafts, or downstream of wood-related industrial complexes. Samples collected at the most northern point of the Skamokawa Creek dredging area (SKRM 0.25) slightly exceeded the 6 percent allowable limit for volatile solids stipulated by the Corps' Portland District guidelines. Volatile solids at the inwater disposal site were relatively low (0.6 percent) compared to the upland disposal area (2 to 3 percent).

20. The roundness grade is a measure of sharpness of the corners of the particles. Angular corners resist displacement but will break and crush under load. Sediments in the dredging area were angular to subangular indicating they were formed recently and are close to their point of origin. This type of sediment resists displacement and will maintain a steeper slope than rounded material. Particles which have been transported in a riverbed are more rounded as is the case with sediment from the inwater disposal site (CRM 32.68 and 32.85). This was expected since the disposal site is close to the main channel of the Columbia River.

21. The grain size distribution curves for Skamokawa Creek, the inwater disposal area, and upland disposal overflow receiving area are presented in figures 3 and 4. A steep curve, such as for sediments collected near the upland and inwater disposal areas, indicate that all the grains have a similar size. The curves of grain diameters for sediment collected in the extraction

area flatten out into the finer ranges indicating the presence of silt and clay. The sediments from SKRM 0.23 and SKRM 0.25 contained 18 to 22 percent silt and clay. Sediments from CRM 33.55 contained 18 percent silt and clay, whereas, sediment from the other disposal areas and SKRM 0.05 contained less than 1 percent silt and clay.

22. In general, sediments collected at SKRM 0.23 and 0.25 are angular, porous, and contain 3 to 6 percent volatile solids and as much as 22 percent silt clay. These sediments are similar to the upland disposal receiving sediments which are angular, porous, contain 1.5 and 3 percent volatile solids and as much as 18 percent silt and clay. The similarity between these sediments results from several factors. The upland disposal site has been used in the past for disposal of dredged material. Additionally, the upland disposal area is directly downstream of Skamokawa Creek and sediments carried from the creek have probably settled there.

23. If Skamokawa Creek dredged sediment was discharged into the inwater disposal area, there would be a short-term change in the sediment characteristics including a higher concentration of organic material and more silt and clay. The new material would be more resistant to downstream movement. If Skamokawa Creek sediment was discharged at the upland disposal area, the overflowing water and sediment slurry would have a minimal impact on the nearby sediment characteristics.

Chemical Characteristics

24. Water Quality. Water quality data at CR 32.68 and SKRM 0.25 are included with the field notes in table 7. These data were collected with a Hydrolab water quality measuring system. The surface temperature was slightly lower in Skamokawa Creek than in the Columbia River (13.9° vs. $14.2^{\circ}C$), but the oxygen concentration was close to saturation at all locations. The pH was slightly basic at both locations; ranging between 8.02 and 8.12. The oxidation/reduction potential reflected healthy, aerobic conditions and the low conductivity (.001 mmhm/cm) indicated that the water contained few free ions.

Generally, the water quality in Skamokawa Creek is high and similar to the Columbia River inwater disposal area.

25. Chemical Analyses. The results of the chemical analyses for elutriate and water samples collected in Skamokawa Creek and the Columbia River are presented in table 2. The water and elutriate data are compared to EPA guidelines [8,9] which provide for the protection and propagation of fish and other aquatic life and for recreation in accordance with the 1983 goals of P.L. 92-500. EPA guidelines are not established for all the substances measured. In these cases, the results are compared to guidelines established by Portland District, Corps of Engineers.[3] It should be remembered that the District's guidelines are not rigid standards and are used only for purposes of comparison.

26. Substances which were found to exceed receiving water levels, and/or the various criteria and guidelines are listed in table 4. These contaminants of concern, present in elutriate water samples, are ammonia and phenol.

Table 4

Contaminants of Concern in Skamokawa Creek Elutriate Samples

	Location			
Contaminant	SKRM 0.05	SKRM 0.23	SKRM 0.25	EPA Guidelines
Ammonia (mg/l)	0.04	0.61	0.99	0.81
Phenol (ug/l)	31	178	210	55-10,200

27. Ammonia. The concentration of ammonia at Skamokawa Creek (RM 0.25) was 0.03 mg/l which slightly exceeds the EPA criteria of 0.02 mg/l. Ammonia results from biological degradation of nitrogenous organic matter. Since this station (RM 0.25) is closest to the area where septic tanks drain into the creek, it seems likely that they are partially responsible for the high value.

The other two, downstream, sampling stations did not have ammonia concentrations which exceeded the EPA guidelines. The ammonia concentration in elutriate samples ranged between 0.001 and 0.006 mg/l at the upland disposal area and between 0.001 and 0.004 mg/l at the inwater disposal site.

28. Ammonia is toxic to fishes and a concentration of 0.2 mg/l is lethal to rainbow trout fry. If Skamokawa Creek dredge material is discharged at the Columbia River inwater site or at the upland disposal site, a short-term increase in the ammonia concentration could occur and initially might slightly exceed the EPA criteria of 0.02 mg/l. This applies only to the material dredged above Skamokawa RM 0.23 which is a small percentage of the total dredging area. The ammonia would quickly be diluted and would <u>not</u> approach concentrations which are lethal to aquatic organisms.

29. <u>Phenol</u>. The phenolic concentration in Skamokawa Creek ranged between 31 and 210 ug/l. These values exceed the 1976 EPA guidelines for phenolic compounds; however, it is unlikely that they exceed the updated 1980 EPA guidelines.[10] The analysis for phenols measures not phenol alone but a whole variety of organic compounds sometimes referred to as "phenolics." The 1980 guidelines do not contain a criterion for phenolics that can be used for direct comparison. Instead, the phenolics are identified separately and the toxicity of the various components range between 30 and 500,000 ug/l (table 5).

30. A comparison between the Skamokawa Creek phenolic values and the seven separate criteria for phenols listed in the guidelines shows that the elutriate samples are much lower than the criteria in six cases. The Skamokawa Creek phenolic values do exceed the guidelines for one chlorinated phenol. However, since most chlorinated phenols are manmade and there are no industrial discharges into Skamokawa Creek, we have no reason to believe that chlorinated phenols are present.

31. The presence of high background levels of phenolic compounds in the Pacific Northwest is associated with decaying vegetation, log rafting, forest product wastes, and livestock. Phenols are highly soluble in water and,in strong solutions,are used as bactericides while in weaker concentrations

phenols are rapidly degraded by bacteria. The process of degrading phenols uses oxygen which can lead to anoxic conditions. Additionally, the toxicity of phenols are enhanced by low dissolved oxygen concentrations, increased salinity, and high temperatures. Fish seem to be much more sensitive to phenols than other aquatic organisms and can be affected by direct toxicity or by imparting an objectionable odor and taste to the fish flesh.

Table 5

EPA Water Quality Criteria for Various Phenolic Compounds

(Federal Register, 28 November 1980)

Phenolic	Suggested Maximum Concentration ug/l
Chlorinated Phenols	30-500,000
2-chlorophenol	4,380
2,4-dichlorophenol	2,020
2,4-dimethylphenol	2,120
Nitrophenols	230
Pentachlorophenol	55
Phenol	10,200

32. At this time it is not possible to completely assess the effects phenolics could have at the disposal site. It appears that inwater disposal would cause a short-term increase in dissolved phenols considerably above ambient levels (4 ug/l). The phenols would rapidly be biodegraded and diluted which might slightly lower dissolved oxygen levels. However, factors which increase the toxicity of phenols such as increased salinity and low dissolved oxygen concentrations are not characteristic of the inwater and upland disposal sites. Additionally, the concentrations of phenols in elutriate samples from the disposal sites ranged between 7 and 210 ug/l suggesting that high phenolic levels are not limited to the extraction site. If, on the other hand, an

agitation dredge is used during summer when water flow is reduced and water temperature is relatively high, phenolics released from the sediment might have the potential to adversely effect aquatic life and water quality.

33. The Corps' Portland District is currently conducting a special study to identify the specific types of phenolic compounds present at dredging sites, and assess the effect of these compounds. These results will be used to complete the phenol assessment at a later time.

Bulk Sediment Analyses

34. Although not specifically required, bulk sediment analyses are useful in evaluating sediments. Results at the extraction site and proposed disposal site can be compared to determine the relative similarity between sediments. If elutriate tests indicate that a particular substance is excessive, the bulk sediment analysis helps to confirm the source and evaluate the magnitude of potential contamination. Elutriate tests measure the short-term release of a substance during disposal as well as indicating those parameters which are not tightly bound to sediments. The bulk sediment analysis gives an indication of indigenous substances that can potentially become soluble. However, when evaluating the data, it must be remembered that bulk sediment analyses measure the total level of the constituent in sediment, including the chemically unavailable and mineralogically-bound components.

35. There are no National or State standards for many of the toxic substances present in sediments as determined by bulk sediment analyses. However, Region V of the U.S. Environmental Protection Agency established guidelines in the publication, "Guidelines for Pollutional Classification of Great Lakes Harbor Sediments."[11] Sediments are classified as nonpolluted, moderately polluted, or heavily polluted, based on data compiled from harbors in the Great Lakes Basin since 1967. Again, these are guidelines, not standards. The bulk sediment analysis and these guidelines have been superseded by the elutriate analysis but are still useful if results are interpreted cautiously.

Table 6

Contaminants of Concern in Skamokawa Creek and Columbia River

Bulk Sediment Analyses

Contaminant	Location SKRM 0.25	CRM 32.68	EPA Region X Guidelines
Arsenic mg/g	9	4	8 H.P.[1]
Barium mg/g	80	30	60 H.P.
Cyanide mg/g	1	1	.25 H.P.
Iron mg/g	21,000	5,900	17,000-25,000 M.P.[2]
Manganese mg/g	400	150	300-500 M.P.
Nickel mg/g	30	10	20-50 M.P.
Phosphorous mg/g	560	400	420-650 M.P.

1. H.P. - Heavily Polluted
2. M.P. - Moderately Polluted

36. Arsenic. On the basis of the EPA's Region V guidelines, sediment at Skamokawa Creek RM 0.25 are "heavily polluted" with arsenic. Arsenic is ubiquitous in nature and is used for a variety of industrial and medical purposes, including formulation of herbicides. It is toxic to aquatic organisms but is not concentrated in the food chain. Compounds of arsenic are insoluble in water and are not readily released during elutriate testing. Since the elutriate samples contained only trace amounts of arsenic, it can be assumed that the arsenic in the dredging site sediments is tightly bound to organic and inorganic compounds which would not be released upon disposal. Comparatively, inwater disposal site sediments contained half the amount of arsenic as the extraction site sediments. This is still considered "moderately polluted." Inwater disposal of Skamokawa Creek dredged materials would increase the insoluble arsenic concentrations in disposal site sediments.

37. Barium. Sediments from Skamokawa Creek are "heavily polluted" with barium and sediments from the inwater disposal site are "moderately polluted." Barium is precipitated so rapidly that it is considered insoluble and non-toxic by the EPA.[12] This explains why there was so little barium in elutriate samples. Disposal of Skamokawa Creek sediments in the Columbia River would increase the barium concentration in existing sediments, but not the barium concentration in the water column.

38. Cyanide. The cyanide concentration at the inwater disposal site and extraction site was identical and these sediments are considered "heavily polluted," so disposal of dredged sediments will not increase background levels in disposal site sediments.

39. Cyanide combines readily with heavy metals including iron. The solubility of cyanide is dependent on pH and the stability of metal-cyanide complexes. Since elutriate samples contained insignificant amounts of cyanide, inwater disposal of the dredged sediments would not have an adverse effect on water quality during discharge operations.

40. Iron. Skamokawa Creek sediment is "moderately polluted" with iron, containing approximately four times more iron than sediments from the inwater disposal site in the Columbia River. Iron is soluble in water only during anaerobic conditions. It forms complexes with many elements such as cyanide and manganese; both of which were excessive in Skamokawa Creek sediments. Inwater disposal of Skamokawa Creek sediments would result in significant additions of insoluble iron above ambient levels, but it would not increase the dissolved iron concentrations in the water column.

41. Manganese. There is approximately three times more manganese in Skamokawa channel sediments that in sediments collected from the inwater disposal sites. The Skamokawa Creek sediments are considered "moderately polluted" under EPA Region V guidelines. Manganese is highly soluble in water but is relatively non-toxic. Inwater disposal of dredged sediments from Skamokawa Creek would result in a short-term release of manganese with the maximum concentrations reaching about one-half (approximately 800 ug/l) of the levels considered toxic to the most sensitive of aquatic organisms. Inwater

disposal in the Columbia River would also increase the ambient sediment concentration of manganese in the disposal area.

42. <u>Nickel</u>. The nickel concentration in extraction site sediment is considered "moderately polluted" and is about three times higher than the levels measured in sediment from the inwater disposal site. Nickel salts are soluble in water but are relatively non-toxic. Since elutriate water samples collected at the same site contained no nickel, it appears that nickel in the sediment is in an insoluble form which would not be released during inwater disposal.

43. <u>Phosphorus</u>. Sediments from Skamokawa Creek are "moderately polluted" with phosphate phosphorous. Phosphorous is generally the growth limiting chemical element in freshwater. If large amounts were released from sediments, the resulting eutrophication could cause excessive growth of aquatic plants leading eventually to water quality deterioration.

44. Under aerobic conditions, iron is released from the sediment oxidizes to form hydrous ferric oxides which scavenge phosphorus from the water column before precipitation to the bottom.[13] The high iron concentration in Skamokawa Creek sediment will effectively prevent phosphorus from being released during disposal of dredged sediments. Evidence of this process is provided by the elutriate tests. Skamokawa Creek sediment (RM 0.25) contains 560 mg/g phosphorus, but elutriate water exposed to the same sediment only contained 22 ug/l dissolved phosphorus. Comparatively, the inwater disposal site sediment contained 400 mg/g phosphorus, but elutriate water mixed with this sediment contained 58 ug/l dissolved phosphorus. The extraction site sediments contain approximately four times more iron than the inwater disposal site sediments. The high iron concentration in the former is attributed with preventing the release of the phosphorus into the water column.

45. The substances discussed above are either insoluble in water or non-toxic. They would not cause adverse impacts during inwater disposal operations. However, in most cases inwater disposal would increase the sediment concentrations of these substances above existing levels. Therefore, upland disposal is recommended.

CONCLUSIONS

46. The physical characteristics of Skamokawa Creek sediment are similar to the inwater sediment near the upland disposal area and dissimilar to sediment from the inwater disposal site. Extraction site sediment is angular, porous, contains 3 to 6 percent volatile solids and as much as 22 percent silt and clay. Inwater disposal site sediment is subrounded, compact, contains less than 0.7 percent volatile solids and has no silt or clay. Comparatively, sediments offshore of the upland disposal site are angular, porous, contain 1.5 to 3 percent volatile solids and as much as 18 percent silt and clay.

47. The ammonia concentration very slightly exceeded guideline limits at one location only, SKRM 0.25 (0.03 versus 0.02 mg/l). Disposal of dredged sediments would have the short-term impact of increasing the ammonia concentration slightly above ambient levels. However, since the amount of dredged material which slightly exceeds the EPA guidelines comprises only a small percentage of the total amount of material to be dredged and it would be rapidly diluted, no impact is expected.

48. The phenolic concentration (31-210 ug/l) was very high compared to ambient levels (4 ug/l). Therefore, disposal of dredged material would have a short-term impact of increasing the phenolic concentration well above ambient levels. Since phenolics are rapidly degraded by bacteria in a process which uses oxygen, the oxygen concentration might decrease below saturated levels. However, this is not expected to adversely affect water quality or aquatic life because the phenolics would rapidly be diluted during disposal, the maximum concentration would not exceed the guidelines for six of the seven phenolics listed by the EPA, and factors which increase the toxicity of phenolics (i.e., increased salinity, low dissolved oxygen concentrations) are not characteristics of the disposal sites.

RECOMMENDATIONS

49. Skamokawa Creek dredged sediments should not be disposed at the proposed inwater disposal site (CRM 32.68 to 32.85). The physical characteristics of

the dredged sediment are significantly different than sediments existing at the inwater disposal site including: greater angularity, greater porosity, higher organic content, and higher percentage of silt and clay. These different characteristics could adversely affect the existing benthic fauna. Additionally, the dredged sediments contain significantly greater concentrations of arsenic, barium, iron, manganese, nickel, and phosphorus.

50. Skamokawa Creek sediments should be removed with a pipeline dredge. The use of agitation dredges at the Skamokawa Creek navigation channel should be limited to periods of high water runoff, and avoided during July and August. Low water flows in Skamokawa Creek have been associated with deteriorating water quality and fish mortalities. Low oxygen concentrations associated with declining water quality could easily change the equilibrium between the water and sediment. The heavy metals present in the sediment in significant amounts could potentially become soluble and be released into the water column in toxic concentrations if agitation dredging is conducted during periods of low water flows.

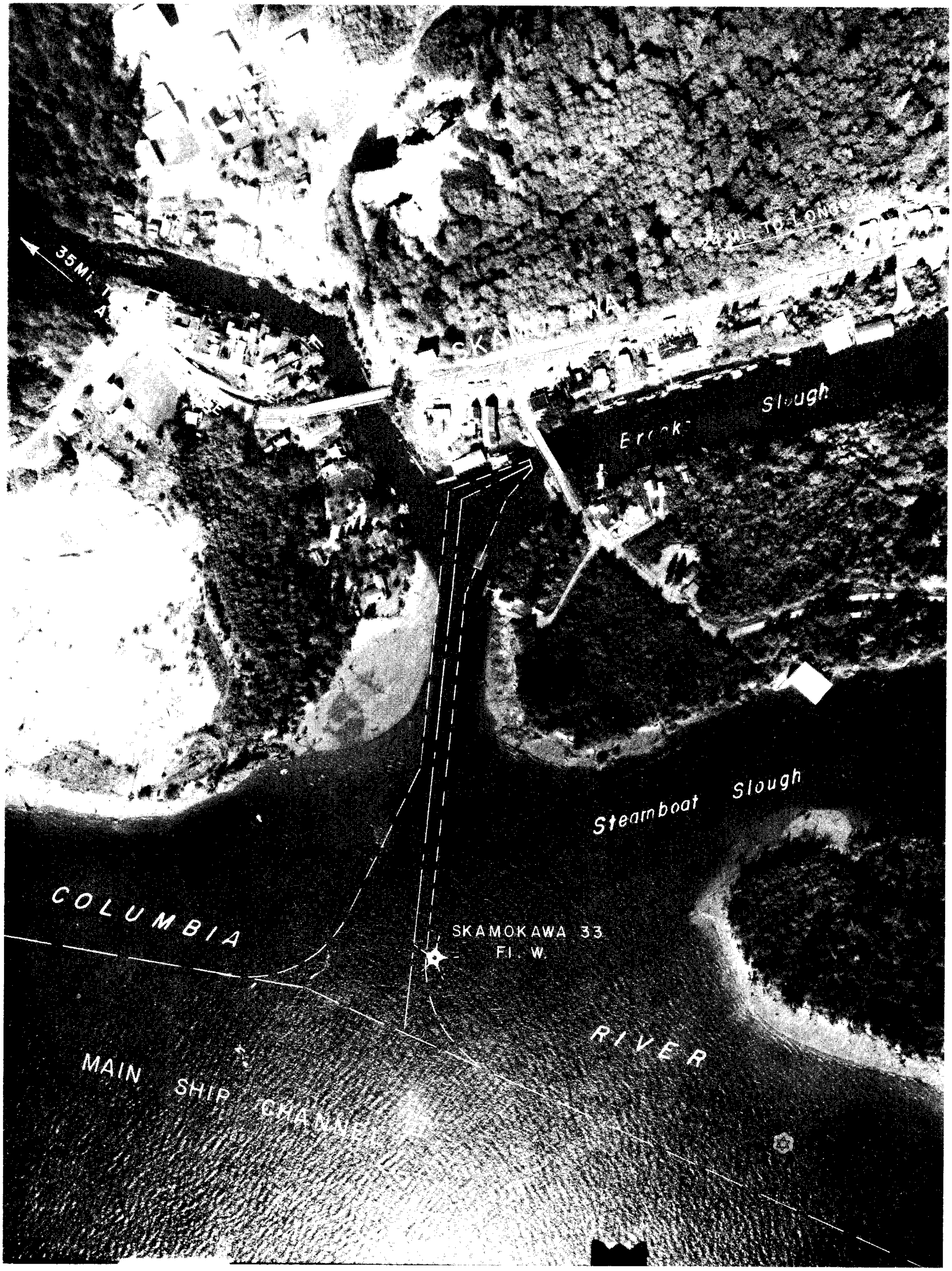


Figure 1. Aerial photograph of Skamokawa Creek, Washington.

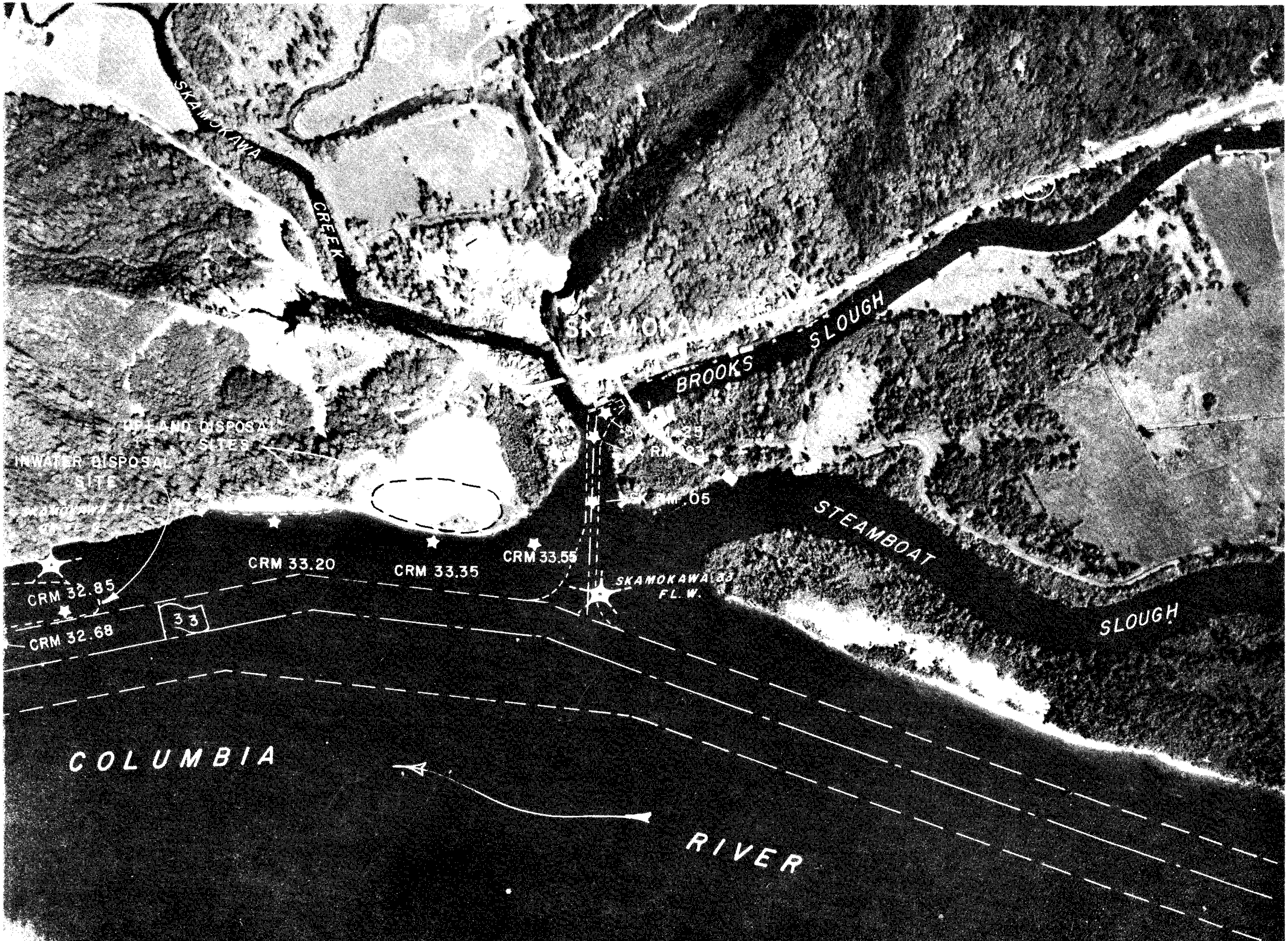
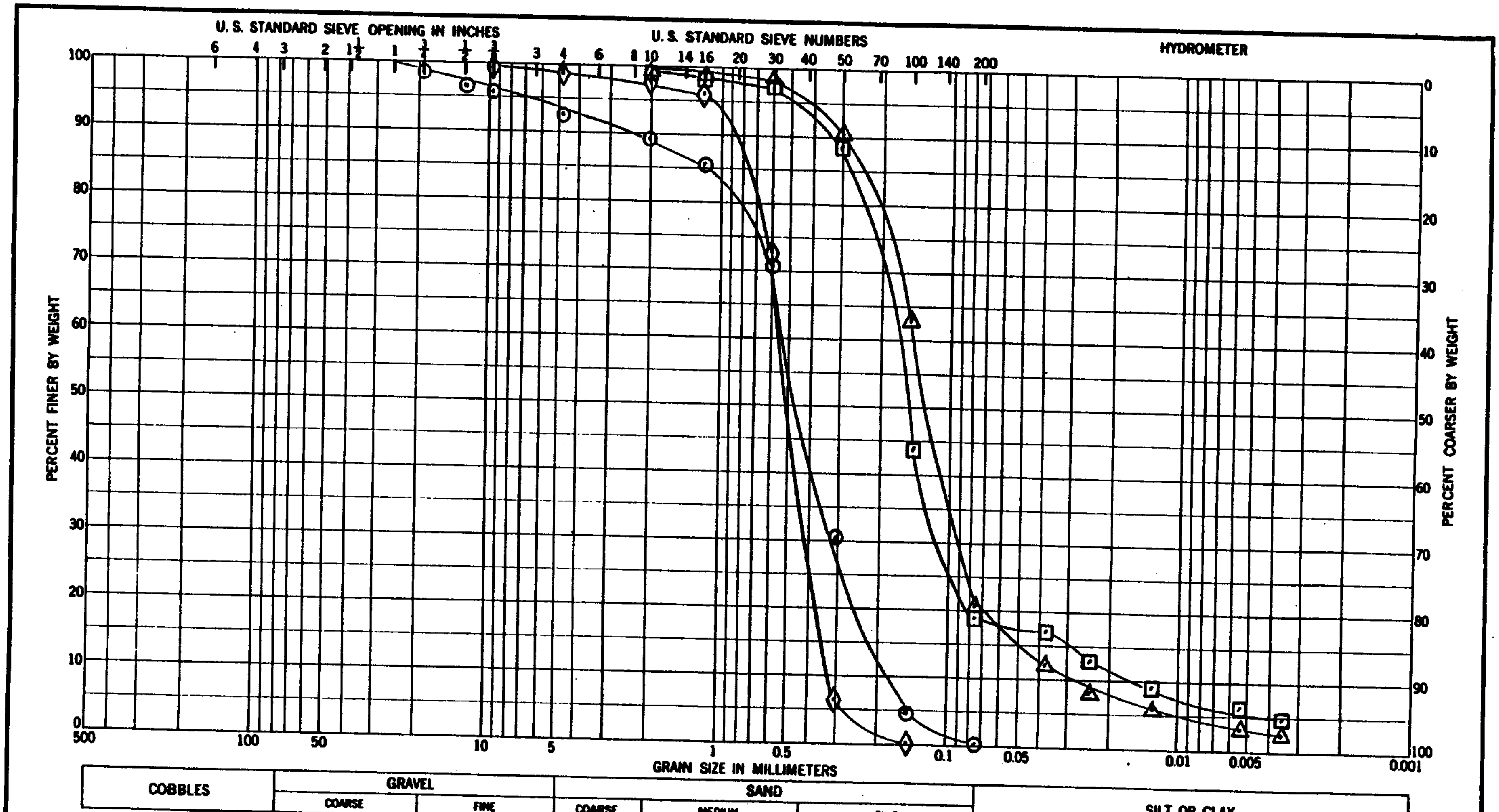


Figure 2. Aerial photograph of Skamokawa Creek showing the navigation channel, sampling locations, and disposal areas.



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
SKRM 0.05	14 May 80 ⊙	SAND (SP)				
SKRM 0.23	15 May 80 △	Silty SAND (SM)				
SKRM 0.25	15 May 80 ⊡	Organic Silty SAND (SM)				
CRM 32.68	14 May 80 ◊	SAND (SP)				

Project RIVER SEDIMENT ANALYSIS

~~Skomokawa Creek, WA~~

Area

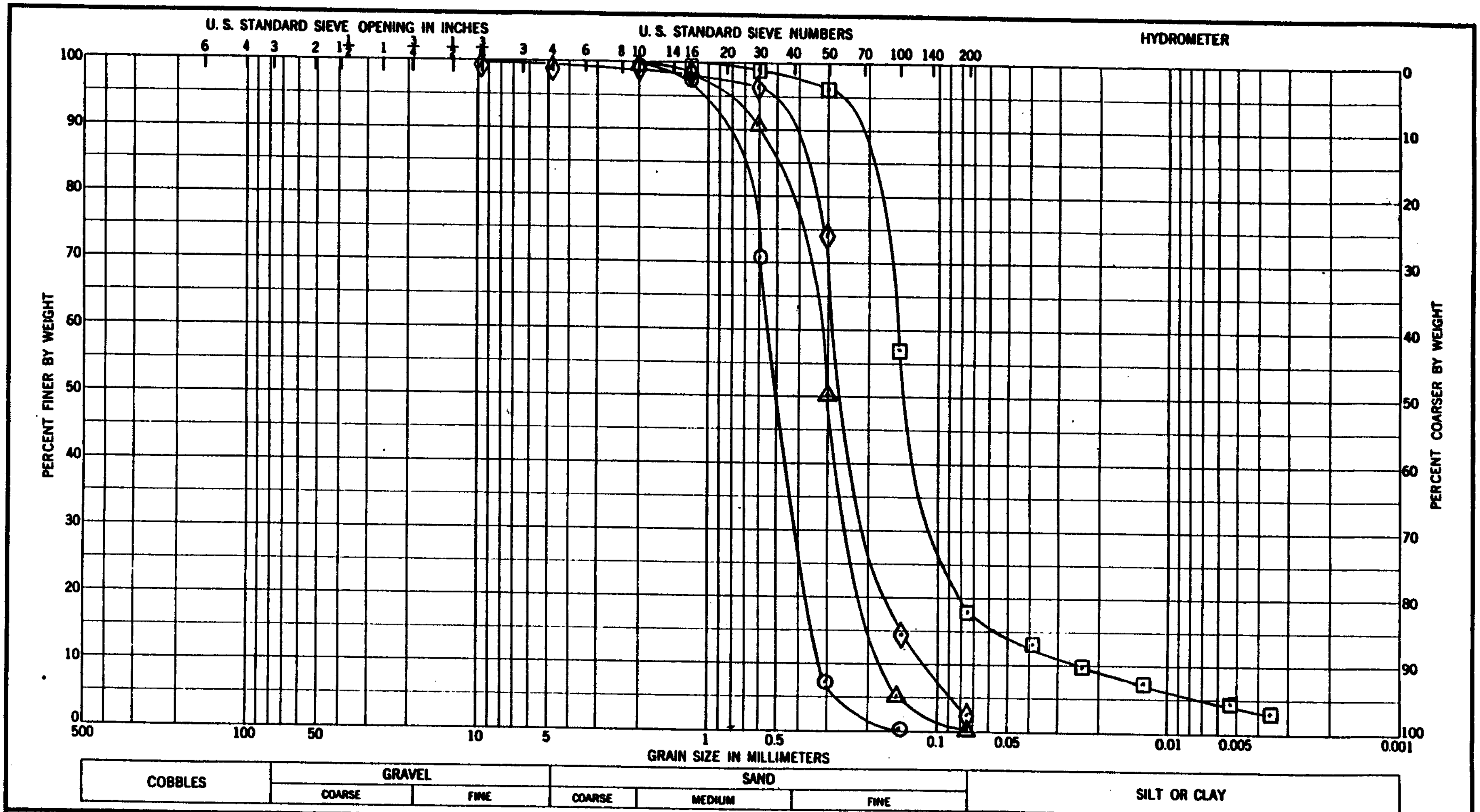
Boring No.

Date 17 Jun 80 (80-S-649)

GRADATION CURVES

NPD

Figure 3. Grain size distribution curves for sediments collected at Skamokawa Creek (SKRM) and the Columbia River (CRM).



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
CRM 32.85	15 May 1980 ⊙	SAND (SP)				
CRM 33.20	15 May 1980 △	SAND (SP)				
CRM 33.35	15 May 1980 ⊡	Silty SAND (SM)				
CRM 33.55	15 May 1980 ◊	SAND (SP)				

Project: RIVER SEDIMENT ANALYSIS

~~Skomokawa Creek, WA~~

Area

Boring No.

Date: 17 Jun 80 (80-S-649)

GRADATION CURVES

NPD

Figure 4. Grain size distribution curves for sediments collected at the Columbia River (CRM).

Table 1. The Physical Characteristics of Sediment from Skamokawa Creek (SKRM) and The Columbia River (CRM) on 14 May 1980.

Sample Identification	Specific Gravity of Wtr	Density of Matl in place gms/liter	Density Median Solids gms/liter	Void Ratio	% Volatile Solids	% Organic Matl	Wtr Content in place	Roundness Grade
SCRM 0.05 14 May 1980	* 1.00	1816	2685	1.065	3.14	4.18	39.7	Angular to Subangular
SCRM 0.23 15 May 1980	* 1.00	1581	2659	1.855	3.22	4.56	69.8	Subangular
SCRM 0.25 15 May 1980	* 1.00	1595	2686	1.833	6.27	12.42	68.2	Subangular
CRM 32.68 14 May 1980	* 1.00	1943	2762	0.868	0.67	0.79	31.4	Subangular to Subrounded
CRM 32.85 15 May 1980	* 1.00	1914	2722	0.883	0.63	0.67	32.5	Subangular to Subrounded
CRM 33.20 15 May 1980	* 1.00	1867	2778	1.052	1.71	1.81	37.9	Angular to Subangular
CRM 33.35 15 May 1980	* 1.00	1556	2730	1.556	3.02	3.50	57.0	Subangular
CRM 33.55 15 May 1980	* 1.00	1765	2744	1.279	2.44	2.55	46.6	Angular to Subangular

** Distilled water used to saturate sample.

Table 2. Results of elutriate tests from sediments collected in Skamokawa Creek and the Columbia River (SKRM - Skamokawa Creek River Mile, CRM - Columbia River Mile).

PARAMETERS	SKOMAKAWA CRM 32.68 (RECEIVING WATER)	CRM 32.68	CRM 32.85	CRM 33.20	CRM 33.35	CRM 33.55	SKRM .05	SKRM .23	SKRM .25	DISTRICT GUIDELINES
ARSENIC, UG/L	1	1							2	440
BARIUM, UG/L	20	10							0	
BERYLLIUM, UG/L	1	1							0	130
CADMIUM, UG/L	.09	1	.29	.14	.07	.06	.25	.13	.23	1.5
CARBON, ORGANIC MG/L	2.4	4.1	3.3	3.1	3	3.1	3.6	6.4	3.5	
CHROMIUM, UG/L	0	0	1	0	0	0	1	24	0	2,000
COPPER, UG/L	0	1	2	2	2	0	4	2	1	12
CYANIDE, UG/L	4	3							3	52
IRON, UG/L	20	80	70	70	80	70	110	50	30	1,000
LEAD, UG/L	28	1	2	0	2	1	2	2	2	74
MANGANESE, UG/L	30	4	0	10	10	0	10	820	670	
MERCURY, UG/L	0	0	0	0	0	0	0	0	0	.0017
NICKEL, UG/L	0	7							0	1.1
NITROGEN, AMMONIA MG/L	.05	.13	.04	.04	.19	.1	.04	.61	.99	.02
NITROGEN, ORGANIC MG/L	1.8	3.4	0	0	0	0	0	0	1.3	
PHENOL,UG/L	4	52	7	210	14	9	31	210	178	10,200
PHOSPHORUS, TOTAL UG/L	47	58							22	
ORTHOPHOSPHATE,UG/L	12	26	16	34	10	12	10	10	10	
SULFATE, MG/L		11								
ZINC, UG/L	9	37	45	6.5	7.8	6.8	68	15	11	180

Table 2. Results of elutriate tests from sediments collected in Skamokawa Creek and the Columbia River (SKRM - Skamokawa Creek River Mile, CRM - Columbia River Mile).

PARAMETERS	SKOMAKAWA CRM 32.68 (RECEIVING WATER)	CRM 32.68	CRM 32.85	CRM 33.20	CRM 33.35	CRM 33.55	SKRM .05	SKRM .23	SKRM .25	DISTRICT GUIDELINES
ALDRIN, UG/L	0	0							0	3
AMETRYNE, UG/L	0	0							0	
ATRATONE, UG/L	0	0							0	
ATRAZINE, UG/L	0	0							0	
CYANAZINE, UG/L	0	0							0	
CYPRAZINE, UG/L	0	0							0	
DDD, UG/L	0	0							0	
DDE, UG/L	0	0							0	1,050
DDT, UG/L	0	0							0	1.1
DIELDRIN, UG/L	0	0							0	2.5
ENDOSULFAN, UG/L	0	0							0	.22
ENDRIN, UG/L	0	0							0	.18
HEPT EPOX, UG/L	0	0							0	
HEPTACHLOR, UG/L	0	.07							0	.5
LINDANE, UG/L	0	.01							0	2
METHOXYCHLOR, UG/L	0	0							0	
MIREX, UG/L	0	0							0	
PCB, UG/L	0	0							0	2
PCN, UG/L	0	0							0	
PERTHANE, UG/L	0	0							0	
PROMETONE, UG/L	0	0							0	
PROMETRYNE, UG/L	0	0							0	
PROPAZINE, UG/L	0	0							0	
SILVEX, UG/L	.01	.01							.01	
SIMAZINE, UG/L	0	0							0	
SIMETONE, UG/L	0	0							0	
SIMETRYNE, UG/L	0	0							0	
TOXAPHENE, UG/L	0	0							0	1.6
2,4-D, UG/L	.01	.01							.04	100
2,4-DP, UG/L	.01	.01							.01	
2,4,5-T, UG/L	.01	.01							.01	

TABLE 3

Results of Bulk Sediment Analyses from Samples Collected at Skamokawa Creek (SKRM) and Columbia River (CRM)

COMPOUND	LOCATION SKRM 0.25	CRM 32.68	EPA Region V Guidelines
Aldrin (ug/kg)	0.1	0.0	—
Arsenic (mg/kg)	9	4	8 HP*
Barium (mg/kg)	80	30	60 HP
Beryllium (mg/kg)	1	0	—
Cadmium (mg/kg)	1	1	6 HP
Carbon Inorg. (g/kg)	0.1	0.0	—
Carbon Org. (g/kg)	133	0.6	—
Carbon Tot. (g/kg)	133	0.6	—
Chlordane (mg/kg)	0	0	—
Chromium (mg/kg)	10	2	75 HP
Copper (mg/kg)	22	5	50 HP
Cyanide (mg/kg)	1	0	.25 HP
DDD (ug/kg)	0.3	0.0	—
DDE (ug/kg)	0.3	0.0	—
DDT (ug/kg)	0.1	0.0	—
Dieldrin (ug/kg)	0.0	0.0	—
Endosulfan (ug/kg)	0.0	0.0	—
Endrin (ug/kg)	0.0	0.0	—
Hept Epox (ug/kg)	0.0	0.0	—
Heptachlor (ug/kg)	0.0	0.0	—
Iron (mg/kg)	21,000	5,900	25,000 HP
Lead (mg/kg)	10	10	60 HP
Lindane (ug/kg)	0.0	0.0	—
Manganese (mg/kg)	400	150.	500 HP
Mercury (mg/kg)	0.03	0.00	1 HP
Mirex (ug/kg)	0.0	0.0	—
Mthxyclr. (ug/kg)	0.0	0.0	—
Nickel (ug/kg)	30	10	50 HP
Nitr - NH_4 (mg/kg)	12	18	200 HP
N. NH_4 + Org. (mg/kg)	320	85	— HP
PCB (ug/kg)	3	0	10,000 HP
PCN (ug/kg)	-	0	—
Perthane (ug/kg)	0.0	0.0	—
Phosph. Tot-P (mg/kg)	560	400	650 HP
Silvex (ug/kg)	0	0	—
Toxaphene (ug/kg)	0	0	—
Zinc (mg/kg)	60	25	200 HP
2,4-D (ug/kg)	0	0	—
2,4-DP (ug/kg)	0	0	—
2,4,5-T (ug/kg)	0	0	—

* HP - Sediments with concentrations exceeding this value are considered "heavily polluted."

FIELD REPORT

Table 7. Field notes and Water Quality data for Skamokawa Creek and the Columbia River

Purpose of Sampling 404 evaluation

Date 14-15 May 1980 Wind

Water Conditions (Wave heights & Direction, Tides, Currents) Columbia was rough - esp. on 5-14-80

Weather Temp 50-75 deg.; drizzled off and on

Sampling Vessel Fort Stevens // P. Livingstone

Sampling Personnel Pam Moore, B. Ellard, F. Rinella, S. MacKenzie

Sampling Gear

Analytical Laboratory USGS and Troutdale

Comments (Wildlife, Sampling Difficulties, etc.)

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
mouth of slough	app 4'	5-15-80	Ellard	Benthos and grain size samples were obtained
SKRM. 15.28				with an Ellard sampler.
Opposite		5-14-80	Corer	Two cores were obtain for Priority B analysis
Grocery				about ½ full-Uniform silty texture. Immediate
Dock				oxygen demand was tested in both samples since
SKRM 0.25				some stratification was present.
Confluence of	approx 6'	5-14-80		For Prior A analysis. Top 2" of sediment were
river & slough				sand and gravel. Gradually grew finer with
SKRM 0.23				depth to a grey silt. Was difficult to get core
			Ellard	sample. For benthos and grainsize. Immediate
				oxygen demand was run on Ellard sample and on silt
				from core sample.
Entrance of harbor		5-14-80	Ellard	For chemistry, benthos and grain size. Sample was
SKRM 0.05 Mid-channel				fine to course sand.

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)
Hand and corer winch cables kept slipping off davits. Corer wasn't heavy enough. Columbia waters were too rough to use corer.

FIELD REPORT

Table 7 (Con't)

Purpose of Sampling 404 evaluation

Date 14-15 May 1980 Wind

Water Conditions (Wave heights & Direction, Tides, Currents) Columbia was rough - esp on 5-14-80

Weather 50-75 deg. drizzled off and on Sampling Vessel Fort Stevens // P. Livingstone

Sampling Personnel Pam Moore, B. Ellard F. Rinella, S. MacKenzie Sampling Gear

Analytical Laboratory USGS and Troutdale

Comments (Wildlife, Sampling Difficulties, etc.)

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
CRM 33.35	6'	5-15-80	Ellard	Chemistry, Benthos and grain size - clean, fine sand with little clay.
CRM 33.35 West end of Upland		"	"	Chemistry, Benthos and Grain size. Fine sand with light clay; wood material present with some clumps of clay.
CRM 33.20 off of Upland Disposal site		"	"	Fine Sand.
CRM 32.68 In open water Disposal site			"	Course sand Benthos, Grain Size and Chemistry

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)
SKRM .23 material was very similar to CRM 33.35 - ei., fine sand with clay and wood particles. Could be indicative of run-off from on shore disposal site.

FIELD REPORT

Table 7 (Con't)

Purpose of Sampling 404 evaluation

Date 14-15 May 1980 Wind

Water Conditions (Wave heights & Direction, Tides, Currents) Columbia was rough, esp. on 5-14-80

Weather 50-75 deg. drizzled off and on Sampling Vessel Fort Stevens // P. Livingstone

Sampling Personnel P. Moore, B. Ellard, F. Rinella, S. MacKenzie Sampling Gear

Analytical Laboratory USGS and Troutdale

Comments (Wildlife, Sampling Difficulties, etc.)

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
CRM 32.85		5-15	Ellard	Benthos, Grain Size and Chemistry. Course sand.
Upstream of Open				
Water Disposal Site				

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)

WATER QUALITY DATA
Table 7 (Con't)

DATE: 15 May 1980

SAMPLING PERSONNEL: P. Moore, B. Ellard
P. Livingstone

WEATHER CONDITIONS: Cloudy, Rain, with periods of sunshine

COMMENTS: (Wildlife, vessel traffic, completion status of training jetty, sampling gear difficulties, sampling vessel, etc.) D.O. was not calibrated. It read 8.80 at 20.7 deg. cel. It should have read 8.73. Barometric pressure was unknown. D.O. data which was taken is considered adequate. THIS WAS DONE THE WEEK BEFORE ST. HELENS MAJOR ERUPTION (Cowlitz at CRM 68.0).

Parameter	Testing Method[1/]	Station								
		A-1	A-2	A-3	B					
Depth	Hydrolab	0.3	7.0	15.5	surface					
Dissolved Oxygen	"	10.31	10.44	10.45	10.70					
Conductivity	"	.001	.001	.001	.001					
Salinity	-									
ORP	"	282	296	291	273					
Temperature	"	14.2	13.8	13.8	13.9					
pH	"	8.07	8.05	8.02	8.12					
Time	approximate	1400	1405	1410	1440					
Maximum Depth										

A - In Water Disposal site off Washington bank at CRM 32.68

B - In Skomakawa turning basin. Approx. 100' downstream of bridge. Was a shallow area.

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